

Wrapped-IMLI: Thermal Insulation for Cryogenic Feed Lines, Phase I

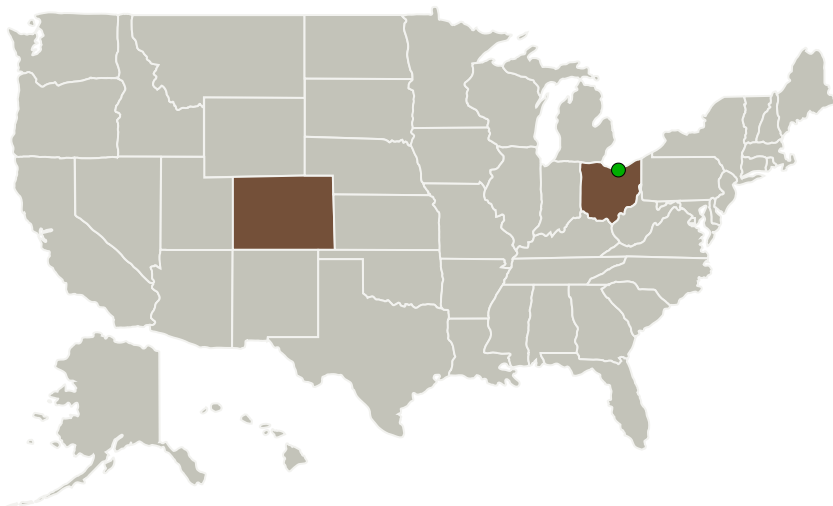
Completed Technology Project (2010 - 2010)



Project Introduction

NASA Exploration vehicles require improved technologies for passive thermal insulation for zero boil-off of cryopropellants during extended LEO and lunar surface missions. Vehicles such as the Earth Departure Stage and Orion must be capable of multi-day orbital operation with minimal cryopropellant loss, and the Altair Lunar Lander must have minimal cryopropellant loss over a six month mission on the lunar surface. Quest Product Development, teaming with Ball Aerospace, proposes an innovative advanced insulation system, Wrapped-IMLI, which could provide high performance thermal insulation for cryogenic feed lines. Wrapped-IMLI is a multi-layer system using proprietary micromolded polymer spacers to precisely control layer spacing and reduce inter-layer heat conduction. IMLI versions of this concept, for cryotanks, have been proven with a measured thermal conductivity of 8.8×10^{-5} W/m-K, 37% lower heat leak than conventional MLI. Preliminary research indicates W-IMLI could provide excellent thermal insulation for cryo-feed lines. Propellant boil-off losses are directly influenced by the MLI, which is the biggest heat leak in cryogenic propellant storage. It is known that MLI insulation for cryogenic propellant feed lines is much less effective than MLI for tank insulation. A Ball Defense Program study indicates the heat leak through spiral-wrapped MLI into lines is up to 10 times worse per area than tank MLI. Better insulation for cryo-feed lines is an important enabling technology for NASA Exploration vehicles. In this Phase I project we would model, conduct a trade study on thermal requirements for NASA spacecraft cryogenic feed lines, design W-IMLI, fabricate a prototype and measure thermal performance.

Primary U.S. Work Locations and Key Partners



Wrapped-IMLI: Thermal Insulation for Cryogenic Feed Lines, Phase I

Table of Contents

Project Introduction	1
Primary U.S. Work Locations and Key Partners	1
Project Transitions	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	2
Technology Areas	3
Target Destinations	3

Wrapped-IMLI: Thermal Insulation for Cryogenic Feed Lines, Phase I



Completed Technology Project (2010 - 2010)

Organizations Performing Work	Role	Type	Location
Quest Thermal Group	Lead Organization	Industry	Arvada, Colorado
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Colorado	Ohio

Project Transitions

January 2010: Project Start

July 2010: Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140650>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Quest Thermal Group

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

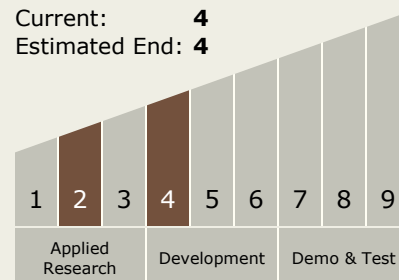
Carlos Torrez

Principal Investigator:

Scott A Dye

Technology Maturity (TRL)

Start: 2
Current: 4
Estimated End: 4



Wrapped-IMLI: Thermal Insulation for Cryogenic Feed Lines, Phase I

Completed Technology Project (2010 - 2010)



Technology Areas

Primary:

- TX01 Propulsion Systems
 - └ TX01.2 Electric Space Propulsion
 - └ TX01.2.1 Integrated Systems and Ancillary Technologies

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System